



University of Illinois
Institute of Natural Resource Sustainability
William Shilts, Executive Director

ILLINOIS NATURAL HISTORY SURVEY
Brian D. Anderson, Director
1816 South Oak Street
Champaign, IL 61820
217-333-6830

Evaluating Water Temperature, Habitat and Fish Communities in Candidate Coolwater Streams in Illinois

Annual Project Report 2010

Brian A. Metzke¹, Leon C. Hinz Jr.¹,
and Ann Marie Holtrop²

¹Illinois Natural History Survey
Institute of Natural Resource Sustainability
University of Illinois at Urbana-Champaign

²Watershed Protection Section
Office of Resource Conservation
Illinois Department of Natural Resources

Prepared for: Illinois Department of Natural Resources

State Wildlife Grant / Project Number (T-13-P-001)

INHS Technical Report 2010(50)
Date of issue: 9 December 2010



ILLINOIS
NATURAL
HISTORY
SURVEY

**University of Illinois
Institute of Natural Resource Sustainability
Illinois Natural History Survey**

***Evaluating Water Temperature, Habitat, and Fish
Communities in Candidate Coolwater Streams in Illinois***

**Annual Project Report 2010
(October 1, 2009 - September 30, 2010)**

Brian A. Metzke, Leon C. Hinz Jr.,
and Ann Marie Holtrop

Submitted to

Illinois Department of Natural Resources
One Natural Resources Way
Springfield, Illinois 62702

Illinois Natural History Survey
Institute of Natural Resource Sustainability
University of Illinois at Urbana-Champaign
1816 South Oak Street
Champaign, Illinois 61820

Illinois Natural History Survey Technical Report 2010(50)
9 December 2010

***Evaluating Water Temperature, Habitat, and Fish
Communities in Candidate Coolwater Streams in Illinois***

Annual Project Report 2010
Project: T-13-P-001

1 October 2009 to 30 September 2010

Brian A. Metzke, Leon C. Hinz Jr.,
and Ann Marie Holtrop

Illinois Natural History Survey
Institute of Natural Resource Sustainability
1816 South Oak Street
Champaign, Illinois 61820

9 December 2010

Dr. Leon C. Hinz, Jr.,
Project Co-Coordinator
Illinois Natural History Survey

Dr. Brian Anderson,
Director
Illinois Natural History Survey

PROJECT TITLE: Evaluating Water Temperature, Habitat, and Fish Communities in Candidate Coolwater Streams in Illinois.

Summary:

Work during this reporting period focused on characterizing temperature, habitat, and biological communities at candidate coolwater sites. During the past year we have collected additional temperature data from 57 candidate streams and other locations and now have records from 232 stream reaches. Eighty-two sites in Illinois have been identified as cool- or coldwater based on these records. Physical habitat surveys have been conducted at 79 sites where temperature data were available. Fish and macroinvertebrate data were obtained from the cooperative basin survey program data managers for candidate sites whenever possible and added to collections made during previous project years. This report summarizes progress for the period beginning 1 October 2009 and ending 30 September 2010. Additional analyses are ongoing and will be presented in the final report upon completion of this project.

JOB 1. Review list of candidate coolwater streams and identify a subset of streams for validation.

Most 2010 temperature logger deployment sites were chosen from one of three groups: locations from the original IDNR coolwater candidate list (Figure 1), locations with prior temperature records (for collection of multi-year data, Figure 2), or randomly selected locations (Figure 3, see Job 4 for selection methods). Temperature data were collected in accordance with procedures defined during previous sample years. Temperature records collected during 2010 were combined with those from previous years for use in Jobs 2-6.

JOB 2. Characterize the thermal regime, habitat (e.g., channel morphology), and vegetation in each stream identified in Job 1.

Fifty-seven temperature records were collected during summer 2010. A total of 280 temperature records from 232 sites have been collected statewide during the course of this project (Figure 4). Thirty-four of these records met the criterion for coldwater streams, while 72 were coolwater (Figure 5).

Throughout the course of this study instream physical habitat surveys were conducted at 79 sites which also have water temperature data. These data are being used to identify patterns in instream habitat and vegetative communities useful for differentiating cold and cool streams from warmwater streams and as an aid in rapid determination of thermal patterns in unsampled streams. Further analysis of habitat and vegetative patterns will be presented in the final report.

Candidate coolwater streams were initially identified using the presence of “coolwater” fish species and output from the Darcy groundwater delivery model. We have temperature records from 66 of the original coolwater candidate sites at this time. More than 80% (29/36) of candidate sites that had candidate fish present and high ground water delivery potential were observed to have coolwater conditions. Candidate sites with “coolwater” fish species present but

without high ground water delivery potential were half as likely to be observed with coolwater conditions (40%; 12/30).

Four additional stream networks (total of 15 during the study) were examined in 2010 for spatial and longitudinal extent of thermal conditions by monitoring temperature in adjacent and neighboring stream segments. These records suggest that thermal regime within a stream network can be a complex mosaic of cool and warm waters related to the interconnectedness of the stream channels and the differential effects of instream cover and ground water inputs (Figure 7).

Spatial temperature patterns were examined by using vertical deployments of temperature loggers. Paired loggers were placed on a single piece of rebar secured in the bottom of ten pools from four stream reaches (one logger near the substrate and the other near the water surface) in an effort to detect the presence of coolwater thermal refugia. At all locations the bottom logger was equal to or cooler than the surface logger. Mean difference in temperature between the paired loggers was 0.3°C with no change in thermal category observed between the top and bottom of any of the pools.

JOB 3. Determine availability and applicability of other data to predict additional coolwater streams.

All sites with temperature data were stratified into five groups based on their observed mean daily July water temperature. Sites were randomly selected within each group to insure that coldwater, coolwater, and warmwater sites were represented in the modeling database. Of the 207 sites available we selected 110 sites with one or more years of July temperature records to develop a new temperature model. Seventy-one sites were withheld from the analysis for model verification including all those from the 2010 random survey (Job 4). GIS summaries of channel characteristics, soil permeability, precipitation, air temperature, surficial and bedrock geology, and landcover for each site were compiled with the observed water temperatures into the modeling database. Model development is ongoing and will be completed before the project end date.

We consolidated fish distribution records for a group of species that have been identified as coldwater, coolwater, and warmwater in the literature. No further work on developing Illinois specific numerical criteria for distinguishing coolwater conditions from coldwater or warmwater was completed during the study period as the revised statewide temperature model is required.

JOB 4. Characterize a subset of streams identified in Job 3.

Thirty sites were randomly selected from stream reaches statewide to provide a simple survey of stream temperatures within wadeable streams in Illinois. Headwater streams and larger rivers were not included in the sampling design. Temperature loggers were placed during the summer following our regular collection procedures. Twenty-four of the deployed loggers were successfully retrieved (Figure 3) with five of these sites were observed to have coolwater

temperature. This limited survey suggests that roughly 20% of wadeable stream reaches (5/24) in Illinois had coolwater characteristics during 2010.

Further evaluation of the stream temperature model developed in 2005 (Figure 1) using available temperatures observed in the field indicates that the model does an excellent job predicting warm water sites (84%) which make up the majority of Illinois streams. However, the model is less accurate at predicting coolwater (31%) or coldwater stream segments (19% correctly identified, although many of these were predicted to be coolwater). We are in the process of redeveloping a stream temperature model using data summaries collected during this project in an effort to improve on the 64% overall accuracy rate of the existing model (see Job 3).

We have a total of 28 sites with multiple year records that span the length of the state (Figure 2). These data suggest that coldwater and warmwater stream segments generally maintain their thermal class between years but that coolwater streams are more variable and can fluctuate between two or even all three thermal classes (Figure 6).

JOB 5. Conduct macroinvertebrate sampling at a subset of sites.

Records from IEPA cooperative basin survey macroinvertebrate collections were used to examine patterns between macroinvertebrate species distributions and stream thermal classes. Analysis is ongoing and will be presented in the final report; however it appears that the species examined in this analysis are not good indicators of thermal class.

JOB 6. Compile and analyze data and write a report.

The annual report was completed identifying 82 coldwater/coolwater sites in Illinois (Figure 5). Preliminary data were presented at the Annual Meeting of Illinois Fisheries Society Meeting (Metzke et al. 2010, February 2010, Rend Lake, IL). Additional analysis is ongoing and a final report describing full results from this study will be completed in 2011.

LITERATURE CITED:

Metzke, B. A., L. Hinz Jr., and A. Holtrop. 2010. Coolwater Streams in Illinois: Where Are They and How Do We Detect Them? Illinois Fisheries Society Meeting, Rend Lake, IL.

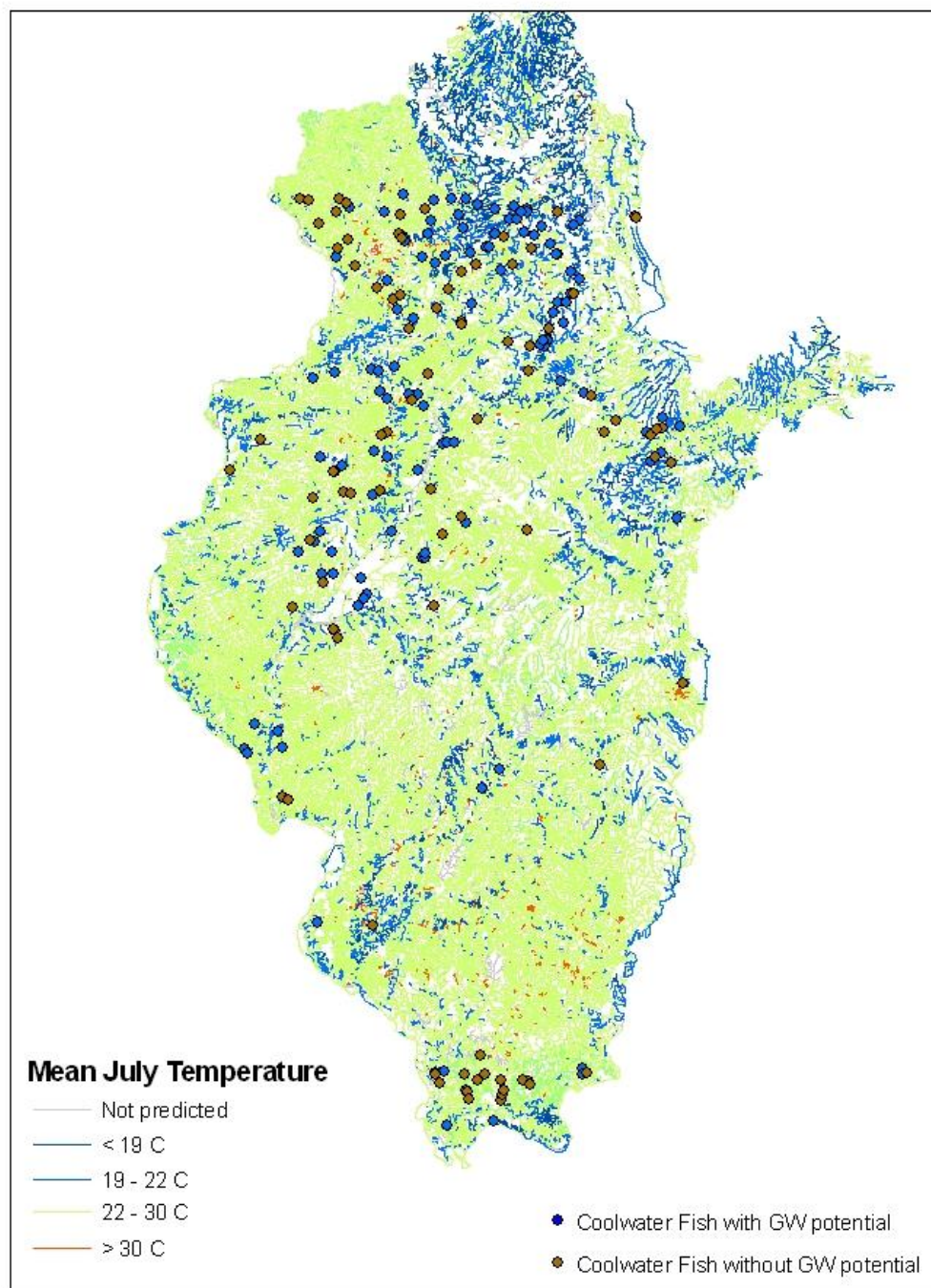


Figure 1. Candidate Coolwater sites and Summer Stream Temperatures based on model output.

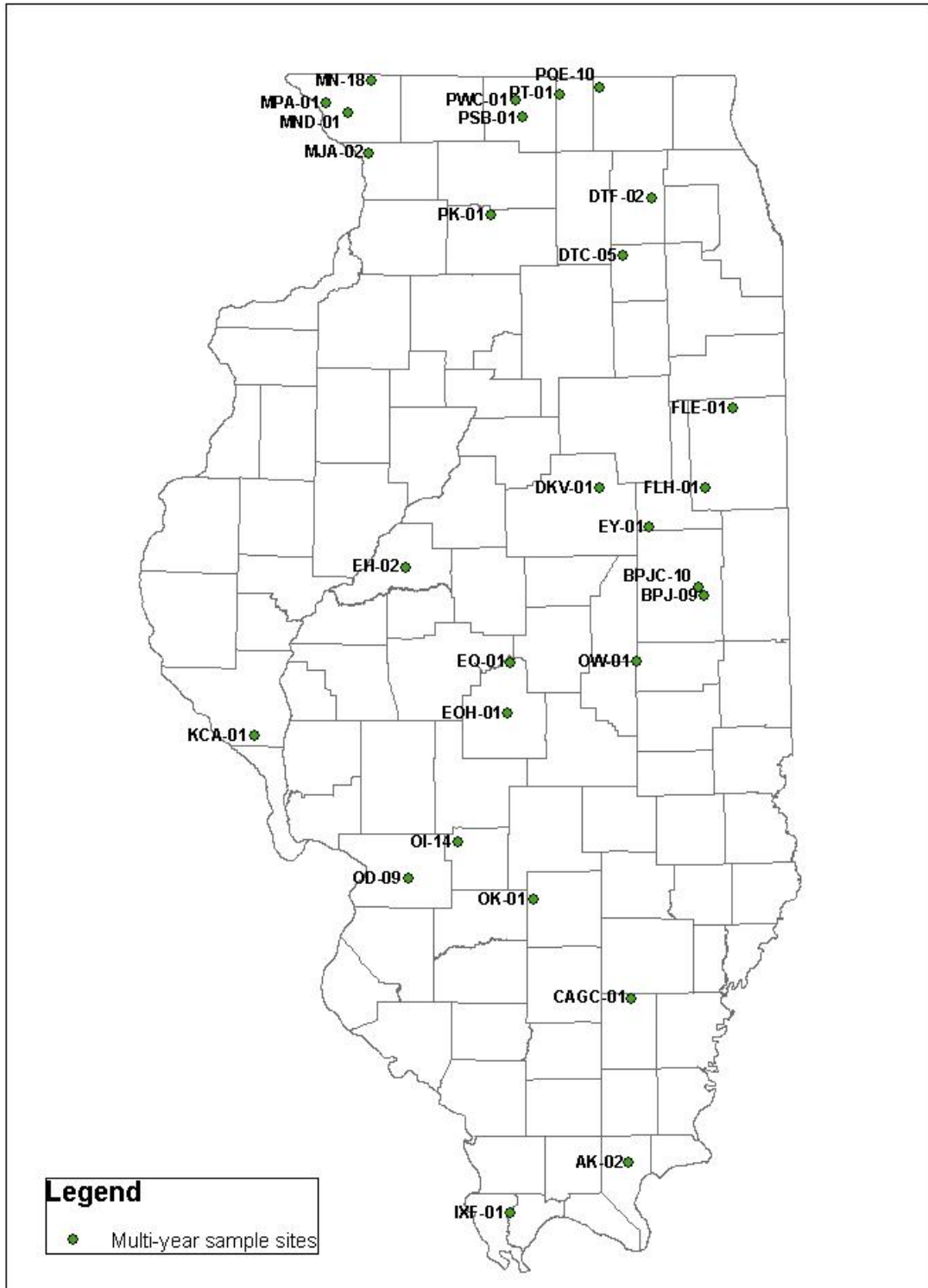


Figure 2. Interannual sample locations.

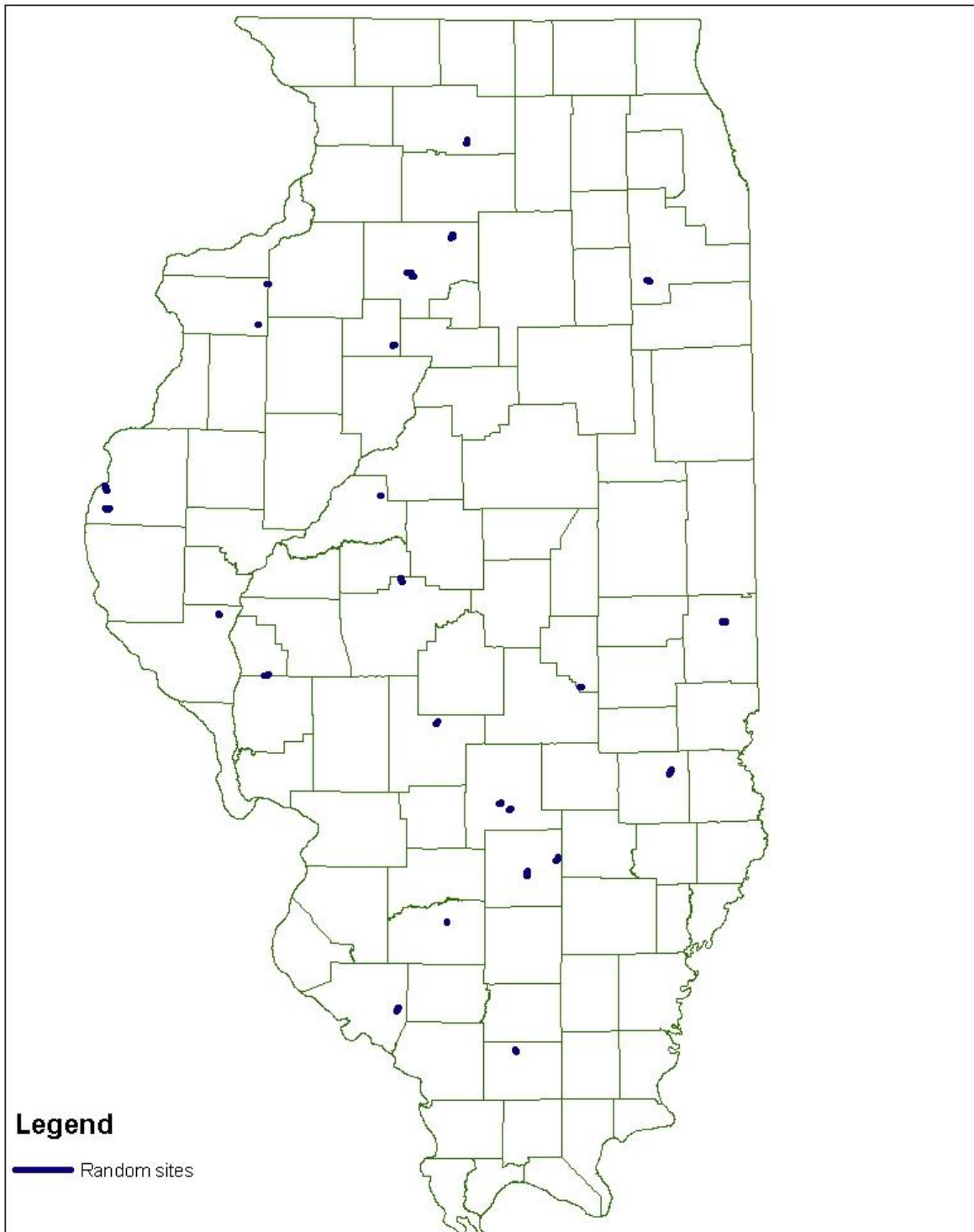


Figure 3. Location of randomly selected monitoring sites.

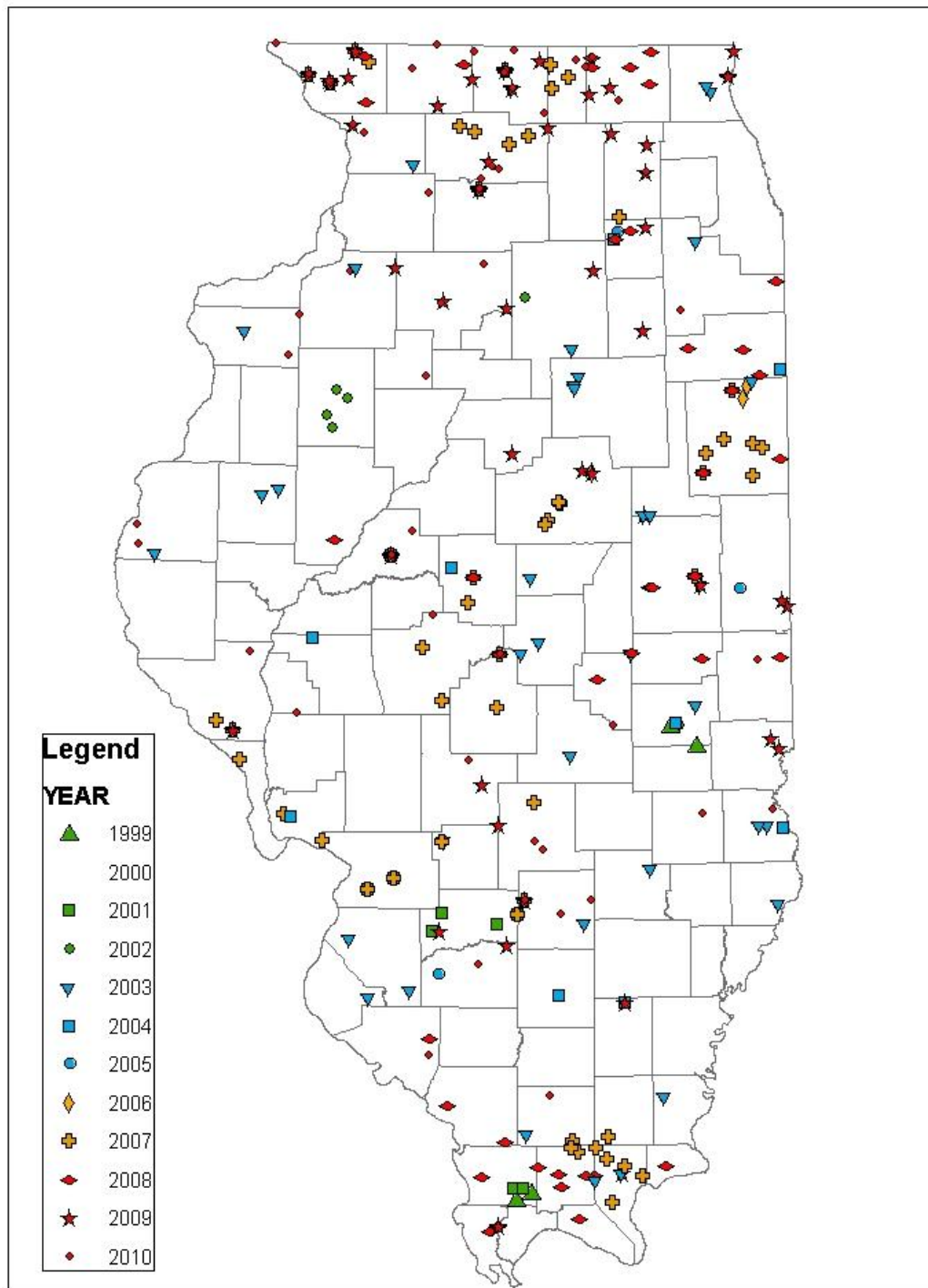


Figure 4. Spatial and temporal distribution of stream temperature records in Illinois.

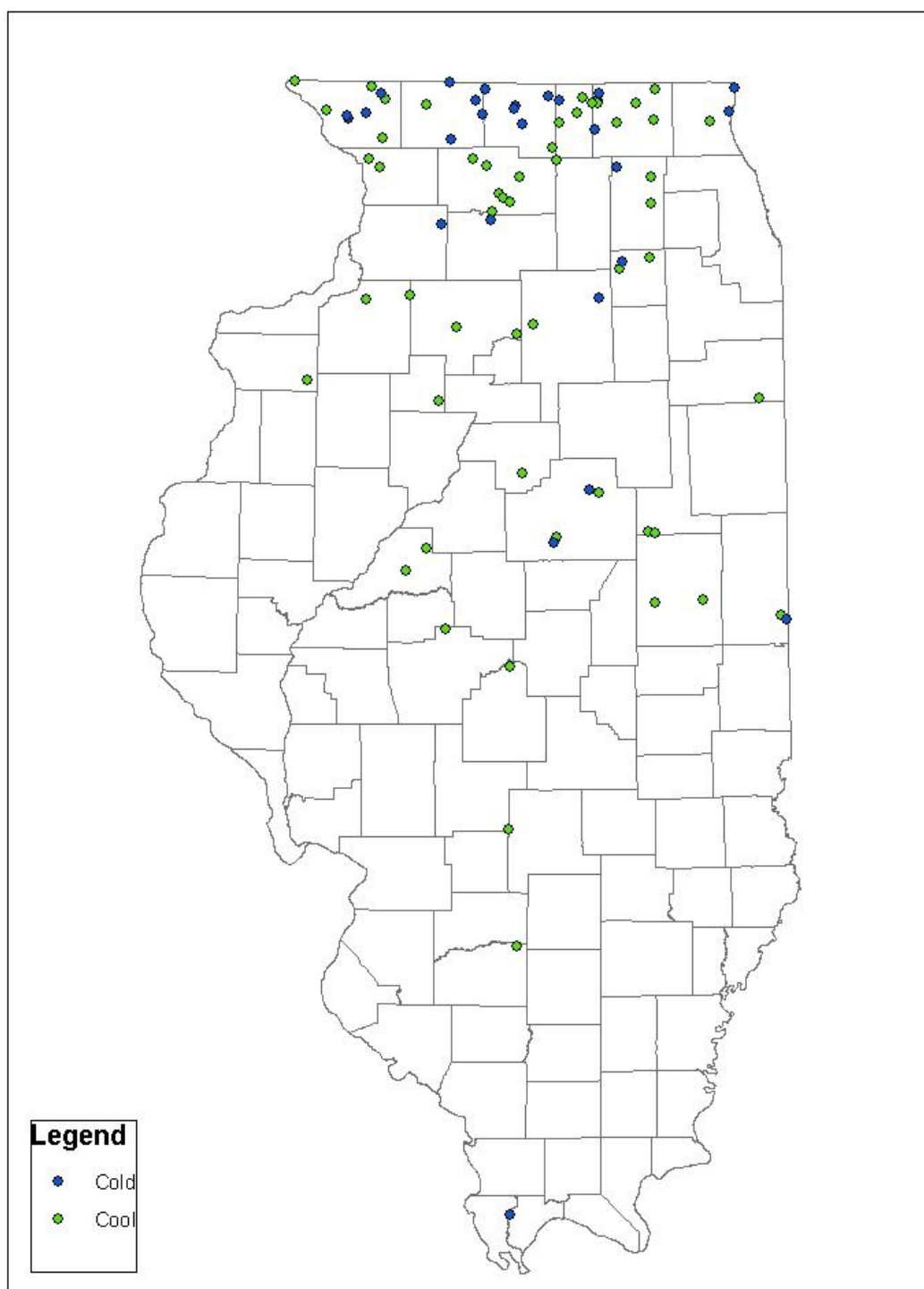


Figure 5. Sites where coldwater or coolwater temperatures were observed during at least one summer during the study period.

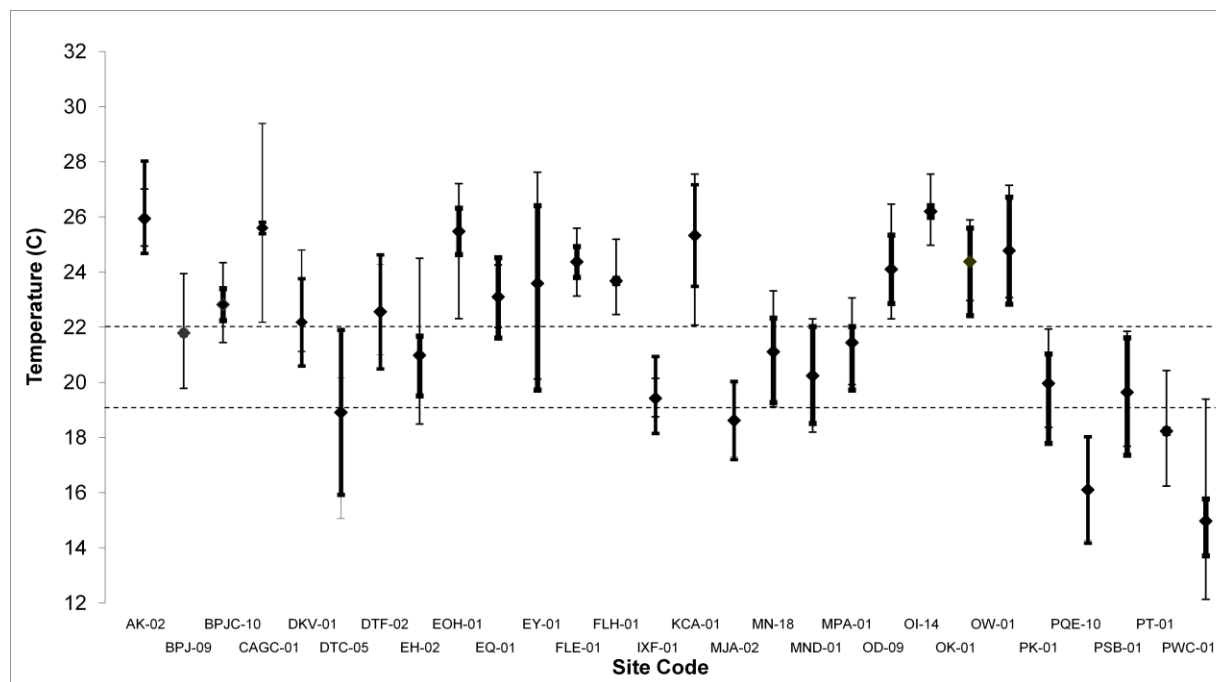


Figure 6. Mean and range of temperatures at interannual sample sites.

- ◆ Mean of mean daily July temperature
- I Range of mean of maximum and minimum mean daily July temperature
- I Range of mean of mean daily July temperature

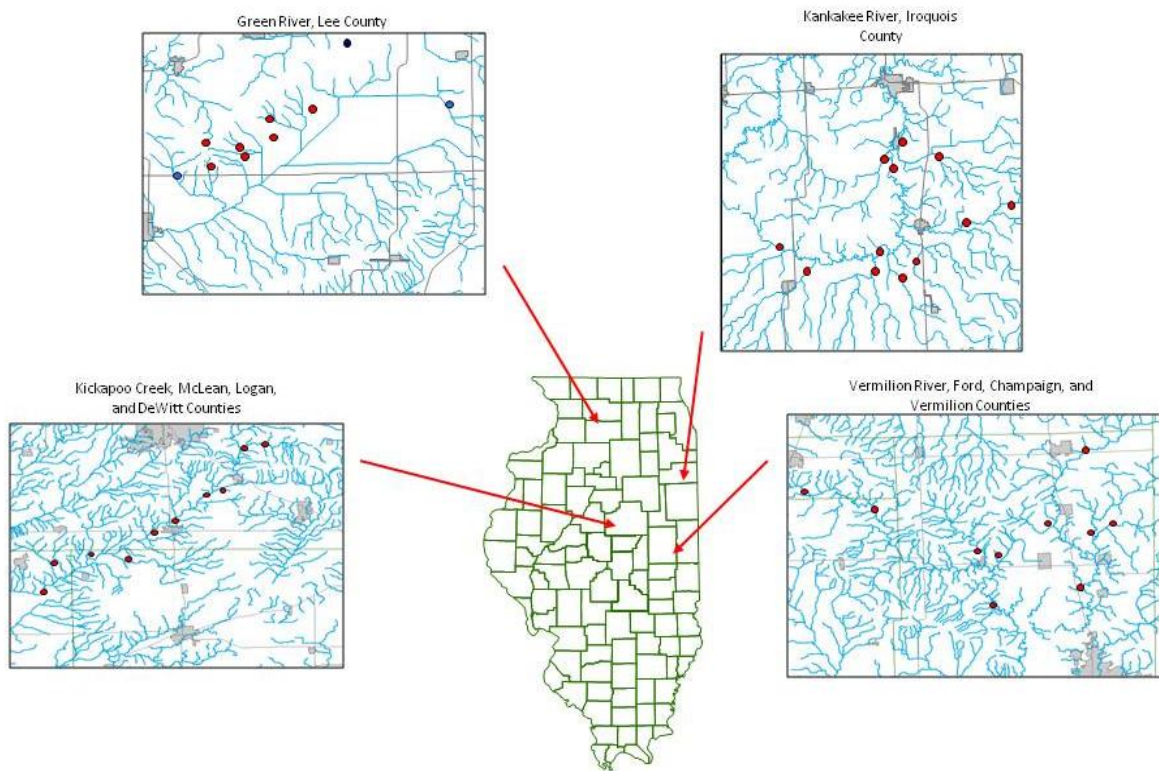


Figure 7. 2010 network sample locations and temperature classes. Coolwater sites are shaded blue, while red sites are warmwater.